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Description

An electronic part such as a rotary- or sliding-type variable resistor, a rotary- or sliding-type code switch or the like which finds use in electronic apparatus includes a board on which various patterns are formed, a casing, and a slider having contacts brought into sliding contact with the patterns formed on the board. The board is fixed to the bottom of the casing and the slider is supported on the board so as to rotate or slide freely. The components such as the board, the casing and the slider are manufactured as separate elements and are subsequently assembled into a finished electronic part by an assembly process.

As the result of success in achieving a reduction in the size and thickness of electronic parts, it has also been attempted to reduce the size and thickness of the casings for rotary- or sliding-type variable resistors and rotary- or sliding-type switches in recent years. However, since the rotary- and sliding-type electronic parts of the conventional construction are composed of elements that are manufactured separately and then assembled into a whole, there is a limitation upon the size and thickness reduction that can be achieved. The more progress that is made in reducing size and thickness, the more difficult it is to assemble the individual elements into the finished product.

An electronic part that has recently been developed is disclosed in the specification of Japanese Patent Public Disclosure (KOKAI) No. 62-49601, by way of example. In this electronic part, electric conductor patterns for electrodes and resistor patterns are formed on a synthetic resin film in such a manner that the resistor patterns are connected to the electric conductor patterns, metallic terminals are fixedly secured to the film to form a terminal portion, and both the terminal portion and the reverse side of the synthetic resin film are molded in a synthetic resin.

Though a reduction in the size and thickness of an electronic part can be obtained by fabricating the casing of a rotary- or sliding-type electronic part through use of the aforementioned technique in which a synthetic resin film is molded of a synthetic resin, various problems need to be solved to achieve this. For example, one problem is how to design the terminal structure formed on the top surface of the film and connected to the terminals of the various patterns.

Accordingly, an object of the present invention is to solve the aforementioned problems and provide a molded resin casing of an electronic part in which a flexible board comprising a thermoplastic synthetic resin film is used as the aforementioned board and is inserted in the casing, thereby integrating the board and the casing to dispense with

the need to assemble the board and the casing, thus making possible a great reduction in size and thickness required for modern electronic parts.

According to the present invention, the foregoing object is attained by providing a molded resin casing as defined in claim 1. According to the invention, there is further provided a process as defined in claim 6.

Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

15 Fig. 1 illustrates the structure of a molded resin casing of an electronic part in which the casing has an internal flexible board in accordance with the present invention, in which Fig. 1(A) is a back view of the casing, Fig. 1(B) a side view of the casing and Fig. 1(C) a plan view of the casing;

20 Figs. 2 and 3(A), (B) are views useful in describing the structure of the flexible board and a method of manufacturing the same;

25 Figs. 4(A), (B) and (C) are views useful in describing a method of inserting the flexible board in the molded resin casing;

30 Fig. 5 is a sectional side view illustrating a rotary-type variable resistor fabricated using a molded resin casing having an internal flexible board;

35 Fig. 6 illustrates the structure of a molded resin casing of an electronic part in which the casing has an internal flexible board in accordance with another embodiment of the present invention, in which Fig. 6(A) is a back view of the casing, Fig. 6(B) a side view of the casing and Fig. 6(C) a plan view of the casing;

40 Fig. 7 is an exploded, perspective view illustrating a rotary-type variable resistor using the molded resin casing shown in Fig. 6;

45 Fig. 8 is a sectional view showing the rotary-type variable resistor in the assembled state;

50 Fig. 9 illustrates the structure of a molded resin casing of an electronic part in which the casing has an internal flexible board in accordance with a third embodiment of the present invention, in which Fig. 9(A) is a plan view of the casing, Fig. 9(B) a partial side section of the same, Fig. 9(C) a back view, and Fig. 9(D) a sectional view taken along line A-A of Fig. 9(A);

55 Figs. 10 and 11(A), (B) are views useful in describing the manufacturing process of a flexible board portion and terminal portion;

Figs. 12(A) and (B) are views useful in describing a method of inserting the flexible board in the molded resin casing;

Fig.13 is a sectional side view illustrating the structure of a sliding-type variable resistor fabricated using the casing of the rotary-type variable resistor;

Figs. 14 and 15 are views illustrating the structure of a molded resin casing of an electronic part in which the casing has an internal flexible board in accordance with a fourth embodiment of the present invention, in which Fig.14 is a perspective view, Fig.15(A) a plan view of the casing,

Fig. 15(B) a partial side section thereof, Fig.15(C) a back view thereof, Fig.15(D) a sectional view taken along line A-A of Fig. 15(A), and Fig.15(E) a sectional view taken along line B-B of Fig.15(B);

Fig.16 is a view for describing a process for manufacturing the flexible board and a terminal portion;

Figs.17(A), (B) and (C) are views useful in describing a method of inserting the flexible board in the molded resin casing;

Fig.18 illustrates the structure of a variable resistor using the molded resin casing of Fig. 14, in which Fig. 18(A) is a partial side section [a sectional view taken along line E-E of Fig.18(B)] and Fig. 18(B) is a sectional view taken along line F-F of Fig.18(A);

Fig.19 is a perspective view illustrating the structure of a molded resin casing of an electronic part in which the casing has an internal flexible board in accordance with a fifth embodiment of the present invention; and

Fig. 20 is a sectional view illustrating a rotary-type variable resistor using the molded resin casing of Fig. 19.

Preferred embodiments of the invention will now be described with reference to the drawings.

Fig. 1 illustrates the structure of a molded resin casing of an electronic part in which the casing has an internal flexible board in accordance with the present invention, in which (A) is a back view of the casing, (B) a side view of the casing and (C) a plan view of the casing. In this embodiment, the description will relate to a rotary-type variable resistor as an example of the electronic part.

As illustrated in the figures, a casing 1 of a rotary-type variable resistor consists of molded synthetic resin from one side of which metallic terminal pieces 2-1 through 2-5 constituting a terminal portion 2 project. A flexible board 3 is inserted within the molded casing 1.

The interior of the molded casing 1 is generally circular in shape and is provided with a side wall 1-2 along its periphery. The bottom of the casing 1 is provided at its central portion with a support 1-1 on which a rotary slider, described below, is supported for free rotation. The back side of the molded

casing 1 is formed to have protrusions 1-3, 1-4.

The flexible board 3 includes collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 formed on a resin film by printing. These collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 on flexible board 3 are exposed at the bottom of the casing 1.

The structure, shape and method of manufacture of the components making up the foregoing rotary-type variable resistor casing will now be described.

Figs. 2 and 3 are views useful in describing the structure and method of manufacturing the flexible board 3 inserted in the molded resin casing of the rotary-type variable resistor set forth above.

To manufacture the flexible board 3, first a strip of thermoplastic, heat-resistant synthetic resin film is prepared. The collector patterns 3-1, 3-2 and the resistor patterns 3-3, 3-4 are formed on predetermined portions of the synthetic resin film by printing, thereby defining a portion corresponding to the flexible board 3, and electric conductor patterns 3-5 through 3-9 are formed on the board portion so as to be continuous with the collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4. After these patterns are formed, the synthetic resin film is cut, leaving the portion corresponding to the flexible board 3 and support strips 10, 11 at the upper and lower ends of the flexible board. In this way a number of flexible boards 3 connected by the support strips

10, 11 can be made. In this case, it is obvious that the formation of the collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 by printing can be carried out after the synthetic resin film is cut leaving the portion corresponding to the flexible board 3 and support strips 10, 11. Examples of the synthetic resin film are films made of polyparabanic acid, polyether imide and polyethylene terephthalate.

Next, metallic terminal pieces 2-1 through 2-5 formed integral with a support strip 20 are prepared. A hot-melt electrically conductive adhesive layer is formed on the electric conductor patterns 3-5 through 3-9 of the flexible board 3, and the tips of the metallic electrode pieces 2-1 through 2-5 are placed on respective ones of these electric conductor patterns 3-5 through 3-9 to be affixed thereto by the adhesive.

Next, a reinforcing sheet 2-6 made of a synthetic resin film of a substance the same as that of the flexible board 3 is placed on the metallic terminal pieces 2-1 through 2-5 that have been affixed to the electric conductor patterns 3-5 through 3-9 of the flexible board 3, a horn (not shown) for emitting ultrasonic waves is placed upon portions [indicated at 2-7 in (A) of Fig. 3] of the reinforcing sheet 2-6 at which the metallic terminal pieces 2-1 through 2-5 are not present, and these portions are irradiated with ultrasonic waves from the horn. As a result, the synthetic resin film forming the reinforce-

ing sheet 2-6 and the synthetic resin film forming the flexible board 3 are fused locally by ultrasonic heating, so that the metallic terminal pieces 2-1 through 2-5 are rigidly secured onto the respective electric conductor patterns 3-5 through 3-9 by the contractile force of the synthetic resin films.

The metallic terminal pieces 2-1 through 2-5 are then heated by a heating iron from above the reinforcing sheet 2-6 or flexible board 3 to melt the aforementioned electrically conductive adhesive layer, thereby reliably bonding the metallic terminal pieces 2-1 through 2-5 onto the electric conductor patterns 3-5 through 3-9.

It should be noted that since the synthetic resin films are strongly fused together by the ultrasonic heating process, it may be permissible in certain cases to omit the step in which the electric conductor patterns 3-5 through 3-9 and the metallic terminal pieces 2-1 through 2-5 are bonded together by the electrically conductive adhesive.

Fig. 3(A) is a plan view showing the metallic terminal pieces 2-1 through 2-5 secured onto the electric conductor patterns 3-5 through 3-9 along the edge of the flexible board, as set forth above, and Fig. 3(B) is a sectional view taken along line D-D of Fig. 3(A). By cutting the flexible board 3 thus manufactured along lines A-A, B-B and C-C in Fig. 3(A), a flexible board 3 having the terminal portion 2 is completed.

The terminal portion 2 of flexible board 3 constructed as described above not only exhibits a strong connection between the flexible board 3 and the metallic terminal pieces 2-1 through 2-5 but is also of a very thin structure whose thickness is the sum solely of the thicknesses of the synthetic resin film forming the flexible board 3, the metallic terminal pieces 2-1 through 2-5, the reinforcing sheet 2-6 and the electrically conductive adhesive layer.

A method of inserting the flexible board 3 having the foregoing construction into the resin molded casing 1 will now be described.

As shown in (A) of Fig. 4, the flexible board 3 is clamped between a first die A and a second die B.

The first die A has a planar, flat surface A1 formed in its central portion, an annular groove S2 formed about the periphery of the flat surface A1, and a columnar hole A3 formed in the central portion of the flat surface A1.

The flat surface A1 is closely contacted by the collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 of the flexible board 3, the annular groove A2 forms the side wall 1-2 of the molded casing 1, and the hole A3 forms the support 1-1 of the molded casing 1.

The second die B is formed to have a recess B1 in a portion to which the flat surface A1 and annular groove A2 of the first die A correspond, a

channel B2 of a prescribed width for promoting the inflow of molten resin toward the terminal portion 2 formed at the edge of the flexible board 3, and a filling bore B3 formed substantially at the central portion of the channel B1.

The recess B1 is for forming the bottom portion of the resin molded casing 1, and the channel B2 is for facilitating the inflow of molten resin to the terminal portion 2, which is formed at the edge of the flexible board 3, when the molten resin is introduced under pressure from the filling bore B3.

As shown in (B) of Fig. 4, a molten resin material (e.g., polyphenylene sulfide, polyethylene terephthalate or the like) is injected under pressure

- 15 from the filling bore B3 of the second die B, as indicated by the arrow D1. Owing to this injection of the molten resin, the molten resin fills the recess B1 and channel B2 of the second die B as well as the annular groove A2 of the first die A, and the synthetic resin film forming the flexible board 3 is punctured by the synthetic resin material, which therefore is allowed to fill the hole A3 that forms the support 1-1 of the molded casing 1, as indicated by arrow D2. As a result of the filling of the hole A3 by the molten synthetic resin material allowed by puncturing of the flexible board 3, the synthetic resin film is brought into close contact with the inner surface of the hole A3 and will not peel away from this inner surface.

- 30 If, instead of adopting the foregoing method, an inflow hole for allowing inflow of the molten resin material were to be provided beforehand in a portion of the flexible board 3 corresponding to the position of the hole A3, the molten resin material which has flowed into the hole A3 through the inflow hole would impact against the inner surface of the hole A3 and reverse in direction. Consequently, this portion of the synthetic resin material would make its way between the flexible board 3 and the wall surface of the first die A, thereby causing the flexible board 3 to separate from the wall surface of the first die A so that the surfaces of the collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 of the flexible board 3 would become covered with the resin material. The result would be a defective product. This problem is solved by allowing the flexible board 3 to be punctured by the injection of the molten resin material, as described above, instead of adopting the arrangement in which the flexible board 3 is provided with the inflow hole in advance.

- 35 If the second die B were not formed to have the channel B2, the molten resin material at the time of filling operation would flow around the die 45 from the recess B1 through the surrounding annular groove A2 and would fill the die from the upper surface of the terminal portion first, as a result of which the terminal portion 2 would be

urged downwardly toward the recess B1 of the second cavity B. In extreme cases, there is the danger that this might cause the terminal portion 2 to become exposed at the back surface of the casing.

In this embodiment, the foregoing problem is avoided by forming the channel B2 in the second die B so that the flow of the molten resin material from the central portion of the recess B1 to the terminal portion 2 will be fastest at the portion (the direction indicated by arrow D3) where it flows in through the channel B2. By virtue of this expedient, the periphery of the terminal portion 2 is filled with the molten resin material while the terminal portion 2 is urged against the wall of the first die A. In other words, since a force indicated by arrow D3 acts before a force produced by the inflow of the molten resin material in the direction of arrow D4 in Fig. 4(B), the terminal portion 2 will not be peeled off the first die A.

After the clearance between the first die A and the second die B is thus filled with the molten resin material and the latter is allowed to solidify, the first and second dies A, B are parted. The result is the molded resin casing 1 incorporating the flexible board 3 inserted therein. It should be noted that the raised surface 1-5 on the back side of the molded casing 1 shown in (A) and (B) of Fig. 1 is formed by the channel B2 of second die B.

In the embodiment described above, the flexible board 3 is not formed to have a molten resin inflow hole at the portion corresponding to the position of the hole A in the first die A. However, if the flexible board 3 is formed beforehand to have a molten resin inflow hole 3a, as shown in (C) of Fig. 4 the molten resin material which has flowed into the hole 3a can be prevented from seeping between the flexible board 3 and the wall surface of the first die A if the diameter d_2 of the hole 3a is made less than one-half the diameter d_1 of the hole A3 for forming the support 1-1. It has been confirmed that the flexible board 3 will not separate from the wall surface of the first die A if such an arrangement is adopted.

Fig. 5 is a side sectional view illustrating a rotary-type variable resistor in which use is made of the above-described molded resin casing having the internal flexible board.

As shown in Fig. 5, a rotor 5 has a structure comprising a disk-shaped rotor main body 5-1 consisting of a synthetic resin, and a slider 5-2 furnished on the bottom surface of the rotor main body 5-1. The support 1-1 of the molded casing 1 is inserted into a hole formed in the central portion of the rotor main body 5-1, and the rotor 5 is freely rotatably supported within the molded casing 1 by thermally caulking the distal end of the support 1-1. Rotating the rotor 5 causes contacts on the slider

5-2 to slide on the collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 formed on the flexible board 3, thereby changing the resistance values between the metallic terminal pieces 2-1 through 2-5.

If the rotary-type variable resistor having the above-described construction is mounted on a printed circuit board 100, the variable resistor is positioned and attached using the protrusions 1-3, 1-4 formed on the back surface of the molded casing 1 near the opposing edges thereof. At such time the metallic terminal pieces 2-1 through 2-5 are positioned on the wiring patterns formed on the printed circuit board 100. Various other electronic parts are placed on the printed circuit board 100 and the parts are mounted in place on the printed circuit board 100 by soldering.

By forming the flexible board 3 of the rotary-type variable resistor of a synthetic resin film and integrating the flexible board 3 with the molded resin casing 1 in the form of an insert within the casing, not only is it no longer necessary to assemble the molded casing 1 and the flexible board 3, but it is also possible to achieve a reduction in size and thickness.

Further, as shown in Fig. 5, the rotary-type variable resistor constructed as described above can be directly mounted on the printed circuit board 100 in the same manner as other parts such as capacitors, resistors and IC chips. This facilitates the automation of the mounting operation.

With the rotary-type variable resistor having the foregoing construction, the terminal portion 2 to which the metallic terminal pieces 2-1 through 2-5 are attached is also inserted inside the molded resin casing 1, as shown in Fig. 5. Therefore, when the rotary-type variable resistor is placed on the printed circuit board 100 and soldered into position via the use of a flux, there is no danger of the flux penetrating the interior of the molded casing 1 through the terminal portion 2.

Further, it has been described in the foregoing embodiment that the patterns are formed on the flexible board 3 by the printing application of an electrically conductive paste. However, the invention is not limited to this embodiment. By way of example, it is possible to form the patterns by forming an electrically conductive foil such as of aluminum or copper on the synthetic resin film by adhesion using an adhesive or by vacuum deposition, followed by forming the foil into predetermined pattern shapes by an etching treatment.

Fig. 6 illustrates the structure of a molded resin casing of an electronic part having an internal flexible board in accordance with a second embodiment of the present invention, in which (A) is a back view of the casing, (B) a side view of the casing and (C) a plan view of the casing. The

casing of this embodiment differs from that shown in Fig. 1 in that the four corners at the periphery of the molded casing 1 are each formed to have a plate-shaped edge portion 1-6 integral with the casing, and each edge portion 1-6 is formed to have an upstanding protrusion 1-7.

Fig. 7 is an exploded, perspective view illustrating a rotary-type variable resistor using the molded resin casing shown in Fig. 6. The rotary-type variable resistor includes the molded resin casing 1, a rotor 6, a cover plate 7 and a rotating knob 8.

The rotor 6 has the shape of a disk and consists of a resin material. The central portion thereof is formed to have a columnar projection 6-4, and the back side is provided with a hole 6-5 coaxial with the projection 6-4. The rotor 6 is also formed to include a pair of locking fingers 6-1, 6-2 on either side of the projection 6-4 for the purpose of attaching the rotating knob 8, and a projection 6-3 for limiting the rotation of the rotor 6 to a predetermined range. Though not shown, a slider 6-6 for coming into sliding contact with the collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 of the flexible board 3 is attached to the lower portion of the rotor 6 (see Fig. 8).

The cover plate 7 comprises a metal plate having a central portion formed to include a through-hole 7-2 through which the locking fingers 6-1, 6-2 of the rotor 6 are passed, and four corner portions each formed to include a hole 7-1 through which a corresponding one of the protrusions 1-7 of molded casing 1 is passed. The central portion of the front edge of the cover plate 7 is provided with a downwardly projecting leg 7-3.

The rotating knob 8 is a disk-shaped member the periphery of which is roughened. As will be described below, a projection 8-4 (see Fig. 8) the central portion whereof is formed to have a hole 8-3 (Fig. 8) into which the projection 6-4 of rotor 6 is inserted is provided on the lower central portion of the rotating knob 8, and holes 8-2, 8-2 into which the locking fingers 6-1, 6-2 of rotor 6 are inserted are formed in the knob 8 on either side of the projection 8-4. The holes 8-2, 8-2 each have a wall face provided with a step portion engaged by the corresponding locking finger. Fig. 8 is a sectional view showing the rotary-type variable resistor comprising the foregoing components in the assembled state mounted on the printed circuit board 100.

To assemble the rotary-type variable resistor, the rotor 6 is placed on the molded resin casing 1 with the support 1-1 formed on the central portion of the molded resin casing 1 being inserted into the hole 6-5 formed in the lower central portion of the rotor 6. Next, the projections 1-7 at the four corners of the molded resin casing 1 are inserted into the holes 7-1 at the four corners of the cover plate 7 and the tips of the projections 1-1 are

thermally caulked, thereby attaching the casing 1 to the cover plate 7. Thus, the projection 6-4 and the pair of locking fingers 6-1, 6-2 of the rotor 6 are passed through the through-hole 7-2 of the cover plate 7.

Next, the projection 6-4 of rotor 6 is inserted into the hole 8-3 formed in the projection 8-4 on the bottom of rotating knob 8, and the locking fingers 6-1, 6-2 are inserted into the holes 8-2, 8-2 and made to engage the step portions formed on the wall faces of the holes 8-2, 8-2, thereby attaching the rotating knob 8 to the rotor 6.

When the rotating knob 8 in the rotary-type variable resistor having the foregoing construction is turned, the rotor 6 rotates so that the slider 6-6 attached to the lower portion thereof is brought into sliding contact with the collector patterns 3-1, 3-2 and resistor patterns 3-3, 3-4 on the flexible board 3. When the rotor 6 rotates a predetermined amount, the projection 6-3 formed on the circumferential portion thereof abuts against a projection 1-8 formed on the inner peripheral surface of the side wall 1-2. As a result, the rotation of rotor 6 is limited to a predetermined range.

In the foregoing embodiment, an example has been described in which the molded casing is that of a rotary-type variable resistor. However, the molded casing can also be used as the molded casing of rotary-type electronic parts such as rotary-type code switches. In such case, most of the component parts of the above-described embodiment can be utilized, and only the shapes of the electric conductor patterns formed on the flexible board 3 need be changed.

Fig. 9 illustrates the structure of a molded resin casing of an electronic part having an internal flexible board in accordance with a third embodiment of the present invention, in which (A) is a plan view of the casing, (B) a partial side section of the same, (C) a back view, and (D) a sectional view taken along line A-A of Fig. 9(A).

In this embodiment, the casing is that of a sliding-type electronic part and includes a flexible board portion 53 and terminal portions 52 integrally formed of a thermoplastic, heat-resistant film 51, with the flexible board portion 53 and the terminal portions 52 being inserted into a molded resin casing 54.

Resistor patterns 53-1 and collector patterns 53-2 are formed on the flexible board portion 53 by printing, and electric conductor patterns 52-1 continuous with the end portions of the collector patterns 53-2 and resistor patterns 53-1 are formed on the terminal portions 52 by printing. The electric conductor patterns 52-1 of the terminal portions 52 are provided with metallic terminal pieces 55. The surface of the flexible board portion 53 on which the resistor patterns 53-1 and the collector patterns

53-2 are formed is exposed at the bottom portion of the molded resin casing 54 in the interior thereof.

The structure, shape and method of manufacture of the components making up the foregoing sliding-type variable resistor casing will now be described.

Fig. 10 is useful in describing a process for manufacturing the flexible board portion 53 and the terminal portions 52. A thermoplastic, heat-resistant film 51 which is rectangular in shape is connected to support strips 51-1, 51-1 at both ends. The two resistor patterns 53-1, 53-1 and the two collector patterns 53-2, 53-2 are formed by printing on the surface of the heat-resistant film 51 at predetermined positions, and the conductor patterns 52-1 are printed on the heat-resistant film so as to be continuous with both ends of the resistor patterns 53-1, 53-1. Conductor patterns 52-1, 52-1 are printed on one end of each of the collector patterns 53-2, 53-2. The portions of the heat-resistant film 51 on which the resistor patterns 53-1 and collector patterns 53-2 are formed by printing define the flexible board portion 53 which serves as the board of the sliding-type resistor, and the portions of the heat-resistant film 51 on which the conductor patterns 52-1 are formed define the terminal portions 52.

As shown in Fig. 10, a plurality (three in the illustration) of the metallic terminal pieces 55 are formed by pressing so as to be integrated with a support strip 58 at a spacing corresponding to that of the electric conductor patterns 52-1. A hot-melt electrically conductive adhesive layer is formed on the electric conductor patterns 52-1 of the terminal portions 52, the metallic electrode pieces 55 are placed on respective ones of these electric conductor patterns 52-1, a terminal securing film 57 of a substance the same as that of the heat-resistant film 51 is placed on the metallic terminal pieces 55 from above, and portions of the terminal securing film 57 at which the metallic terminal pieces 55 are not present are irradiated with ultrasonic waves from a horn (not shown) which emits ultrasonic waves. As a result, the terminal securing film 57 and the heat-resistant film 51 of the terminal portions 52 are fused by ultrasonic heating, so that the metallic terminal pieces 55 are rigidly bonded to the respective electric conductor patterns 52-1. The metallic terminal pieces 55 are then contacted and heated by a heating iron from above the terminal securing film 57 or the heat-resistant film 51 of the terminal portion 52 to melt the aforementioned electrically conductive adhesive layer, thereby reliably bonding the metallic terminal pieces 55 onto the electric conductor patterns 52-1.

Fig. 11 illustrates the state in which the metallic terminal pieces 55 have been attached to the elec-

tric conductor patterns 52-1 of the terminal portion 52 by the above-described process, in which (A) is a plan view and (B) a sectional view taken along line B-B of Fig. 11(A). It should be noted that since the terminal securing film 57 and heat-resistant film 51 are strongly fused together by the ultrasonic heating process so that the metallic terminal pieces 55 and the electric conductor patterns 52-1 are brought into highly reliable surface-to-surface pressurized contact, it may be permissible in certain cases to omit the step in which the electrically conductive adhesive layer is formed on the electric conductor patterns 52-1.

The board with the metallic terminals of the sliding-type variable resistor formed as described above is very thin since the thickness thereof, even at the terminal portion where the thickness is greatest, is the sum solely of the thicknesses of the heat-resistant film 51, the metallic terminal pieces 55 and the terminal securing film 57.

The flexible board portion 53 of the heat-resistant film having the metallic terminal pieces 55 attached thereto as described above is inserted into the molded synthetic resin casing 54 in such a manner that the metallic terminal pieces 55 project to the outside. Thereafter, the molded product is cut along the lines C-C and D-D in Fig. 11(A) to thereby remove the support strips 58. The product is then cut along lines E-E and F-F in Fig. 11(A) to thereby remove the overlapped portions of the support strips 51-1 and terminal securing films 57, thus completing the molding casing 54 of the sliding-type variable resistor.

The side portions of the casing 54 are formed so as to cover the outer peripheries of the flexible board portion 53 and the terminal portions 52, and four securing projections 54-2 for securing a cover plate, described below, and four guide projections 54-3 for guiding the cover plate are formed at both ends on one side portion 54-1. The rear side of the casing is integrally formed to include two fixing projections 54-4, 54-4 for fixing the molded resin casing 54 to a printed circuit board, described below.

Next, a method of inserting the heat-resistant film 51 having the metallic terminal pieces 55 attached to the terminal portions 52 into the molded resin casing 54 will be described with reference to Fig. 12.

As shown in (A) of Fig. 12, the flexible board portion 53 and the terminal portions are formed integral with each other and the heat-resistant film 51 having the metallic terminal pieces 55 attached to the terminal portions 52 is clamped between a first die A and a second die B.

The first die A is formed to have a flat surface A1 which is brought into close contact with the surface of the flexible board portion 53 of the heat-

resistant film 51 having the resistor patterns 53-1 and collector patterns 53-2 formed thereon, and a groove A2 for forming the side portions 54-1 of the molded casing 54. Though not shown, the bottom portion of the groove A2 is formed to have recesses for forming the securing projections 54-2 and the guide projections 54-3 of the molded resin casing 54.

The second die B has a recess B1 for forming the bottom portion of the molded casing 54 formed at a portion thereof which corresponds to the flat portion A1 and groove A2 of the first die A, and a channel B2 of a predetermined width for promoting the inflow of a molten resin material toward the terminal portions 52 of the heat-resistant film 51 and the parts of the side portions 54-1 penetrated by the metallic terminal pieces 54-1. The channel B2 is formed longitudinally of the recess B1 at the approximate center thereof. (An elongated projection on the rear side of the molding casing 54 is formed by this channel B2.) The second die B also has columnar recesses B3 formed at the center of the recess B1 at predetermined positions longitudinally thereof for forming the fixing projections 54-4, 54-4 on the rear side of the molded casing 54. Though not shown, the peripheral portion of the bottom of recess B1 is formed to have recesses for forming projections 54-6 on the molded casing 54.

Next, as shown in (B) of Fig. 12, a molten resin material (e.g., polypylene sulfide, polyethylene terephthalate or the like) is injected under pressure in the direction of the arrows D1 from filling bores B4 formed at the base ends of the recesses B3 of the second die B. Owing to this injection of the molten resin, the heat-resistant film 51 of the flexible board portion 53 is urged against the flat surface A1 of the first die A.

If the elongated channel B2 extending longitudinally along the center of the recess B1 of the second die B were not provided, the molten resin material at the time of the charging operation would flow around the die from the recess B1 through the surrounding groove A2 and would fill the die from the upper surface of the flexible board portion 53 and terminal portions 52 at the periphery thereof, as indicated by arrow D2. As a result, the peripheral portions of the flexible board portion 53 and terminal portions 52 would be urged downwardly toward the recess B1 of the second cavity B. In extreme cases, there is the danger that this might cause the peripheral portions to become exposed at the back surface of the molded casing 54.

In this embodiment, the foregoing problem is avoided by forming the channel B2 longitudinally of the recess B1 along the center thereof in the second die B so that the flow of the molten resin material is promoted by the channel B2. The injection of the molten resin material is such that first

the recess B1 is filled from the longitudinal direction thereof along its center (the direction indicated by arrow D3), then the periphery of the cavity is gradually filled, and finally the groove A2 at which the peripheral portions of the flexible board 53 and terminal portions 52 are located is filled. During this filling process, therefore, the flexible board portion 53 and the terminal portions 52 are urged against the side of the first die A, so that they will not separate from the flat surface A1 of the first die A. In other words, the molten resin material will not flow into the area between the flat surface A1 of the first die A and the flexible board portion 53. Consequently, when the first and second dies A, B are parted after the molten resin material solidifies, as will be described below, the surface of the flexible board portion 53 will be completely exposed at the bottom of the molded resin casing 54.

After the molten resin material thus charged into the area between the first and second dies A, B has solidified, the first and second dies A, B are parted. As a result, a casing of a sliding-type variable resistor such as that shown in Fig. 9 is completed.

Fig. 13 is a side sectional view illustrating the structure of a sliding-type variable resistor in which use is made of the above-described sliding-type variable resistor casing.

As illustrated, a sliding body 59 is placed upon the flexible board portion 53 of the heat-resistant film 51 inserted into the molded resin casing 54. Provided on the bottom portion of the sliding body 59 is a slider 60 brought into sliding contact with the resistor patterns 53-1 and collector patterns 53-2 formed on the flexible board 53. The upper portion of the sliding body 59 is formed integral with an operating lever 59a. A cover plate 61 is placed upon the upper part of the side portions 54-1 of molded casing 54 and the distal ends of the securing projections 54-2 are thermally caulked, whereby the sliding body 59 is retained between cover plate 61 and the flexible board portion 53. This completes the sliding-type variable resistor.

When the operating lever 59a in the sliding-type variable resistor having the above-described structure is operated to move the sliding body 59, the slider 60 slides on the resistor patterns 53-1 and collector patterns 53-2 to change the positions at which the contacts of the slider 60 contact the resistor patterns 53-1, thereby changing the resistance between the metallic terminal pieces 55 connected to respective ones of the collector patterns 53-2 and resistor patterns 53-1.

As described hereinabove, the flexible board portion 53 on which the resistor patterns 53-1 and collector patterns 53-2 are formed and the terminal portions 52 on which the electric conductor patterns 52-1 are formed are made of the thermoplas-

tic, heat-resistant film 51 consisting of synthetic resin, and the heat-resistant film 51 is insertion-molded in the molded casing 54 consisting of synthetic resin. As a result, not only is it no longer necessary to assemble the molded casing 54 and the flexible board portion 53, but it is also possible to reduce the size and thickness of the sliding-type variable resistor.

In the foregoing embodiment, the invention is described in connection with a sliding-type variable resistor. However, the invention can be applied to a sliding-type code switch by changing the patterns formed on the flexible board portion 53.

Furthermore, though the structure adopted in the foregoing embodiment is one in which the metallic terminal pieces 55 project from both ends of the molded casing 54, it is possible to adopt a structure in which the metallic terminal pieces are provided on only one end of the casing.

Further, it has been described in the foregoing embodiment that the patterns are formed on the flexible board 53 by the printing application of an electrically conductive paste. However, the invention is not limited to this embodiment. By way of example, it is possible to form the patterns by forming an electrically conductive foil such as of aluminum or copper on the synthetic resin film by adhesion using an adhesive or by vacuum deposition, followed by forming the foil into predetermined pattern shapes by an etching treatment.

Figs. 14 and 15 are views illustrating the structure of a molded resin casing of an electronic part in which the casing has an internal flexible board in accordance with a fourth embodiment of the present invention, in which Fig. 14 is a perspective view, Fig. 15(A) a plan view of the casing, (B) a partial side section thereof, (C) a back view thereof, (D) a sectional view taken along line A-A of Fig. 15(A), and (E) a sectional view taken along line B-B of Fig. 15(B). In this embodiment, a variable resistor will be described as the electronic part.

As illustrated, the casing of the electronic part has a structure in which a flexible board 73 (described below) printed with resistor patterns 73-1, 73-1 and collector patterns 73-2, 73-2 and board extension portions 73-3 printed with lead patterns 72-1, 72-1 continuous with the respective end portions of the resistor patterns 73-1, 73-1 are integrally formed of a heat-resistant film 71. Metallic terminal pieces 75 are brought into contact with and rigidly secured to the upper surfaces of the lead patterns 72-1, 72-1 on the board extension portions 73-3 to define terminal portions 72, and the flexible board 73 and terminal portions 72 of the heat-resistant film 71 are inserted into a molded resin casing 74. The resistor patterns 73-1, 73-1 on the heat-resistant film 71 are exposed at the bottom surface of the casing, and the collector

patterns 73-2, 73-2 are exposed at the two opposing inner side wall surfaces of the casing.

The arrangement and method of manufacture of the components making up the foregoing electronic part casing will now be described.

Fig. 16 is a view useful in describing a process for manufacturing the flexible board 73 and the terminal portions 72. A thermoplastic, heat-resistant film 71 which is rectangular in shape is connected to support strips 71-1, 71-1 at both ends. Examples of the material usable to form the heat-resistant film 71 are polyparabanic acid, polyether imide and polyethylene. Two resistor patterns 73-1, 73-1 and two collector patterns 73-2, 73-2 are printed on the surface of the heat-resistant film 71 at predetermined positions to define a flexible board 73, and lead patterns 72-1, 72-1 are printed on the board extension portions 73-3 that are continuous with the flexible board 73. The resistor patterns 73-1, 73-2 and lead patterns 72-1 are connected in such a manner that one end of each resistor pattern 73-1 is connected to one end of the corresponding collector pattern 73-2 and one end of a lead pattern 72-1 is connected to the junction of the resistor and collector patterns 73-1, 73-2. The width of the flexible board 73 of the heat-resistant film 71 is a predetermined dimension larger than the width of the board extension portion 73-3.

As illustrated, a plurality (two in the illustration) of metallic terminal pieces 75 are formed integral with a support strip 78.

A hot-melt electrically conductive adhesive layer is formed on the lead patterns 72-1 on each of the board extension portions 73-3 of heat-resistant film 71, and the respective end portions of the metallic electrode pieces 75 are placed thereon. Next, a terminal securing film 77 of a substance the same as that of the heat-resistant film 71 is placed on the metallic terminal pieces 75 from above, and portions of the terminal securing film 77 at which the metallic terminal pieces 75 are not present, namely portions between the metallic terminal pieces 75, 75, and both end portions are irradiated with ultrasonic waves from a horn (not shown) which emits ultrasonic waves. As a result, the terminal securing film 77 and the board extension portions 73-3 of the heat-resistant film 71 are fused by ultrasonic heating, so that the metallic terminal pieces 75 are rigidly bonded to the respective lead patterns 72-1, 72-1 [see (E) of Fig. 15].

The metallic terminal pieces 75 are then contacted and heated by a heating iron from above the terminal securing film 77 or the board extension portion 73-3 to melt the aforementioned hot melt-type electrically conductive adhesive layer, thereby reliably bonding the metallic terminal pieces 75

onto the lead patterns 72-1. A terminal portion 72 is thus formed on the board extension portion 73-3 of the heat-resistant film 71.

The board with the metallic terminals of the variable resistor formed as described above is very thin since the thickness thereof, even at the terminal portion where the thickness is greatest, is the sum solely of the thicknesses of the heat-resistant film 71, the metallic terminal pieces 75 and the terminal securing film 77.

The flexible board portion 73 of the heat-resistant film 71 having the metallic terminal pieces 75 attached thereto as described above is inserted into a molded synthetic resin casing 74 in such a manner that the metallic terminal pieces 75 project to the outside. Thereafter, the molded product is cut along the lines C-C and D-D in Fig. 16 to thereby remove the support strips 78 and 71-1, 71-1, thereby completing the molded casing of the variable resistor.

The side portions 74-1 of the molded resin casing 74 are formed so as to cover the outer peripheries of the flexible board portion 73 and the terminal portions 72, and projections 74-3 serving as stoppers are formed at both ends on one side of the casing 74. In addition, sloping surfaces 74-2 which slope inwardly of the casing 74 are formed at predetermined positions on the tops of the side portions 74-1.

Next, a method of inserting the flexible board 73 having the terminal portions 72 into the molded resin casing 74 will be described with reference to Fig. 17.

First, as shown in Fig. 17(A), the flexible board 73 and the terminal portions 72 are clamped between a first die A and second die B.

The first die A is formed to have a flat surface A1 which is brought into close contact with the surface of the flexible board portion 73 having the resistor patterns 73-1, 73-1 formed thereon, flat surfaces A3 brought into intimate contact with the surfaces of the terminal portions 72, and a groove A2 provided around the flat surfaces A1, A3 for forming the side portions 74-1 of the molded casing 74.

The second die B has a recess B1 for forming the bottom portion of the molded casing 74 formed at a portion thereof which corresponds to the flat surface A1, flat surface A3 and groove A2 of the first die A. In addition, projections B2, B2 are provided in the recess B1 at a predetermined spacing for the purpose of impeding the flow of a molten resin material in the longitudinal direction of the heat-resistant film 71 and promoting the flow of the molten resin material in the lateral direction of the film 71. Further, a filling bore B3 for charging a molten resin material is formed in the center of the recess B1.

A molten resin, such as polyphenylene sulfide, polyethylene terephthalate or the like, is introduced from the filling bore B3 under pressure as indicated by the arrow D1. Owing to the injection of the molten resin, the resin material flows into the recess B1 of the second die B. The flow of the resin material in the lateral direction (at right angles to the plane of the drawing) of the heat-resistant film 71 is promoted by the projections B2 formed in the recess B1, as shown in (C) of Fig. 17. As a result, the collector patterns 73-2 on the flexible board 73 of the heat-resistant film 71 are urged by the molten resin material, as shown in (B) of Fig. 17, so that the collector patterns 73-2 are bent along one side surface of the groove A2 and are thus brought into close contact with the side surface.

If the recess B1 of the second die B were not provided with the projections B2, B2, the molten resin would flow radially from the filling bore B3 when introduced from the bore. In such case, the molten resin material which flows longitudinally of the recess B1 would flow into the groove A2 from the side portions of the terminal portions 2 and part of this resin would enter the area between the side surface of the groove A2 and the parts of the flexible board 73 on which the collector patterns 73-2 are formed, resulting in the surfaces of the collector patterns 73-2 being covered with the resin material. However, since in this embodiment the

projections B2 are formed on the bottom of the recess B1, the flow of the molten resin material in the longitudinal direction of the recess B1 is impeded, while the flow of the molten resin in the lateral direction of the heat-resistant film 71 is promoted. Accordingly, the molten resin material which thus flows into the groove A2 causes the surface of the flexible board 73 to be bent along the side surface of the groove A2, thus bringing the surface of the flexible board into close contact

with the side surface of the groove. Thus, the front surfaces of the collector patterns 73-2 of flexible board 73 will not be covered with the resin material.

More specifically, since the molten resin material will not flow into the area between the side surfaces of the flat surface A1 of the first die A and the flexible board 73, when the first die A and the second die B are parted after the resin material has solidified, as described below, the resistor patterns

73-1, 73-1 on the flexible board 73 are exposed at the bottom of the molded casing 74, and the collector patterns 73-2, 73-2 are exposed at the two opposing inner side walls.

After the molten resin material thus charged in the cavity between the first and second dies A, B has solidified, the first and second dies are parted. As a result, a variable resistor casing such as that shown in Fig. 14 is completed.

Fig. 18 shows the structure of a variable resistor fabricated using the above-described molded resin casing 74, in which (A) is a partial side section [a sectional view taken along line E-E of Fig. 18(B)] and (B) is a transverse sectional view [a sectional view taken along line F-F of Fig. 18(A)]. As illustrated, a slider 80 is provided on the outer periphery of the variable resistor casing having the above-described structure. The slider 80 is molded of a resin material and has an operating knob 81 integral with one side portion thereof. Numeral 83 denotes contacts in sliding contact with the resistor patterns 73-1, 73-1 on the flexible board 73. Numeral 84 denotes contacts in sliding contact with the collector patterns 73-2. The contacts 83 and 84 are formed integral with each other in the form of a contact member 85, which is inserted in the body of the slider 85. Further, a pair of engagement members 82, 82 that are engaged with two edge portions of the outer surface of the bottom of the molded casing 74 are formed on both sides of the slider 80.

With the upper part of the molded casing 74 abutting against the engagement members 82, 82 of the slider 80 having the above-described structure, the slider 80 is pressed. As a result, the engagement members 82 are spread apart, in which state they descend along the outer side surfaces of the slider 80 and, eventually, the respective projections of the engagement members 82, 82 engage with the outer peripheral bottom surface of the casing 74. Thus, a variable resistor prepared using the molded resin casing 74 is completed.

When the operating knob 81 of the variable resistor having the above-described construction is operated to move the slider 80 longitudinally of the molded resin casing 74, the contacts 83, 84 are caused to slide on the respective upper surfaces of the resistor patterns 73-1 and collector patterns 73-2, thus causing a change in the resistance between the metallic terminal pieces 75, 75.

In the foregoing embodiment, an arrangement has been described in which the collector patterns 73-2 on the flexible board 73 are exposed at the two opposing inner side wall surfaces of the molded casing 74.

As has been described above, the flexible board 73 formed with the resistor patterns 73-1, 73-1 and collector patterns 73-2, 73-2 and the board extension portions 73-3 formed with the lead patterns 72-1, 72-1 are formed using a heat-resistant film 71 of a thermoplastic resin, and the heat-resistant film 71 is arranged in such a manner that the resistor patterns 73-1, 73-1 are exposed at the bottom surface of the casing 74, while the collector patterns 73-2, 73-2 are exposed at the two opposing inner side wall surfaces. Therefore, it is possi-

ble to effectively utilize the inner surfaces of the molded casing 74 and, hence, reduce the size and thickness of the variable resistor, and it is no longer necessary to assemble the flexible board 73 and the molded casing 74 together.

Although in the above-described embodiments the present invention has been described by way of example in which the invention is applied to a sliding-type variable resistor, it should be noted that the molded casing of the invention is not limited thereto but can be utilized as the molded casing of a sliding-type switch as well. For example, it is possible to fabricate a miniature code switch by forming fixed contact patterns of a code switch on the inner bottom surface and both inner side surfaces of the above-described molded resin casing 74.

Further, it has been described in the foregoing embodiment that the patterns are formed on the flexible board 73 by the printing application of an electrically conductive paste. However, the invention is not limited to this embodiment. By way of example, it is possible to form the patterns by forming an electrically conductive foil such as of aluminum or copper on the synthetic resin film by adhesion using an adhesive or by vacuum deposition, followed by forming the foil into predetermined pattern shapes by an etching treatment.

Fig. 19 is a perspective view illustrating the structure of a molded resin casing of an electronic part having an internal flexible board in accordance with a fifth embodiment of the present invention. In this embodiment, the flexible board 73 is inserted into a molded resin casing 91 so as to be exposed at the inner surface of a side wall 91-2 and the outer peripheral surface of a support 91-1 of the casing 91. The method of inserting the flexible board 93 into the molded casing 91 is substantially the same as the methods indicated in Figs. 4 and 17 and need not be described again.

By adopting this arrangement, a resistor pattern 93-4 is exposed at the inner surface of the side wall 91-2 of the molded resin casing 91, a resistor pattern 93-3 and a collector pattern 93-2 are exposed at the inner bottom surface, and a collector pattern 93-1 is exposed at the outer peripheral surface of the support 91-1. Further, a terminal portion 92 has a structure substantially the same as that of the terminal portion 2 of the molded resin casing illustrated in Fig. 1 and is provided with metallic terminal pieces 92-1 through 92-5.

Fig. 20 is a sectional view showing the rotary-type variable resistor, which is fabricated using the molded resin casing 91 having the above-described construction, mounted on the printed circuit board 100. The structure of this arrangement is substantially the same as that of the rotary-type

variable resistor of Figs. 7 and 8.

To assemble this rotary-type variable resistor, a rotor 98 is placed on the molded resin casing 91 with the support 91-1 formed on the central portion of the molded resin casing 91 being inserted into a hole 98-5 formed in the lower central portion of the rotor 98. Locking fingers 98-1, 98-2 are inserted into holes 98-2, 98-2 and made to engage step portions formed on the wall surfaces of the holes 98-2, 98-2, thereby attaching the rotating knob 98 to the rotor 98.

When the rotating knob 98 in the rotary-type variable resistor having the foregoing construction is turned, the rotor 98 rotates so that a slider 98-6 attached to the lower surface thereof is brought into sliding contact with the resistor pattern 93-2 and collector pattern 93-2 exposed at the inner bottom surface of the casing 91, a slider 98-7 attached to the inner peripheral surface of the rotor 98 is brought into sliding contact with the collector pattern 93-1 exposed at the outer peripheral surface of the support 91-1, and a slider 98-8 attached to the outer peripheral surface of the rotor 98 is brought into sliding contact with the resistor pattern 93-3 exposed at the inner surface of the side wall 91-2. This causes the resistance between the metallic terminal pieces 92-1 through 92-5 to change.

By constructing the molded resin casing in the manner described above, the inner surface of the molding casing 91 can be utilized effectively to make it possible to greatly reduce the size of the rotary-type variable resistor.

Although in the above-described embodiments the present invention has been described by way of example in which the invention is applied to a variable resistor, it should be noted that the molded casing of the invention can be utilized as the molded casing of a rotary-type code switch or the like by changing the various patterns formed on the flexible board.

Further, in the foregoing embodiment, the patterns can be formed on the flexible board 93 by the printing application of an electrically conductive paste, and it is possible to form the patterns by forming an electrically conductive foil such as of aluminum or copper on the synthetic resin film by adhesion using an adhesive or by vacuum deposition, followed by forming the foil into predetermined pattern shapes by an etching treatment.

Claims

1. A molded resin casing of an electronic part, the casing interiorly accommodating a flexible board (3) on which are formed electric conductor patterns (3-5, 3-6, 3-7, 3-8, 3-9) slidably contacted by contacts of a slider of the electronic part, said casing including said flexible

- 5 board being comprised by a synthetic resin film and the electric conductor patterns formed on said synthetic resin film, metallic terminal pieces (2-1, 2-2, 2-3, 2-4, 2-5) being joined to upper surfaces of end portions of said electric conductor patterns, a securing resin film (2-6) being comprised of a synthetic resin film of the same substance as that of said flexible board placed upon said metallic terminal pieces, a terminal portion being provided by locally fusing said securing resin film and the film of said flexible board so as to sandwich distal ends of the metallic terminal pieces, said flexible board (3) being inserted into the synthetic resin casing in such a manner that predetermined portions of said metallic terminal pieces are exposed to the outside of the casing and said electric conductor patterns are exposed to the interior of said casing, and in such a manner that said flexible board and synthetic resin casing are integrated.
- 10 2. The molded resin casing according to Claim 1, wherein the interior of said synthetic resin casing is formed to be substantially circular in shape, a support (1-1) for freely rotatably supporting a rotor is formed integral with the synthetic resin casing at a central portion thereof, and said electric conductor patterns of said flexible board are exposed in substantially concentric circles to an inner bottom portion of the casing with said support at the center.
- 15 3. The molded resin casing according to Claim 1 or 2, wherein said flexible board is formed to be a predetermined amount larger than an inner bottom surface of the synthetic resin casing, and said electric conductor patterns are exposed to the inner bottom portion of said casing and an outer peripheral surface of the support or an inner surface of a side wall.
- 20 4. The molded resin casing according to Claim 1, wherein the interior of said synthetic resin casing is formed to be rectangular in shape, in such a manner the slider of a sliding-type electronic component is capable of sliding, and the electric conductor patterns of said flexible board are formed substantially in parallel with long sides of the rectangular shape.
- 25 5. The molded resin casing according to Claim 4, wherein said flexible board is formed to be a predetermined amount larger than the inner bottom surface of the synthetic resin casing, and said electric conductor patterns are exposed to the bottom portion and an inner surface of a side wall of said synthetic resin

casing.

6. A process for manufacturing the molded synthetic resin casing of any one of claims 1 to 5 of an electronic part, the casing interiorly accommodating a flexible board (3) on which are formed electric conductor patterns (3-5, 3-6, 3-7, 3-8, 3-9) slidably contacted by contacts of a slider of the electronic part, said casing including said flexible board being comprised by a synthetic resin film and the electric conductor patterns formed on said synthetic resin film, metallic terminal pieces (2-1, 2-2, 2-3, 2-4, 2-5) being joined to upper surfaces of end portions of said electric conductor patterns, a securing resin film (2-6) being comprised of a synthetic resin film of the same substance as that of said flexible board placed upon said metallic terminal pieces, a terminal portion being provided by locally fusing said securing resin film and the film of said flexible board so as to sandwich distal ends of the metallic terminal pieces, said flexible board being inserted into the synthetic resin casing in such a manner that predetermined portions of said metallic terminal pieces are exposed to the outside of the casing and said electric conductor patterns are exposed to the interior of said casing, and in such a manner that said flexible board and synthetic resin casing are integrated, comprising the steps of:

preparing a first die (A) having a flat surface (A1) which is brought into close contact with the surface of the flexible board comprising said resin film on which the electric conductor patterns are formed, and a groove (A2) formed around the periphery of said flat surface for forming a side portion of the synthetic resin casing, and a second die (B) disposed in opposing relation to said first die and having casing bottom forming recess (B1) formed at a portion thereof corresponding to that portion of said first die which includes said flat surface and at least a part of said groove;

clamping said flexible board between said first die (A) and said second die (B) in such a manner that the surface having said electric conductor patterns formed thereon is brought into abutting contact with the flat surface of said first die; and

filling a cavity between said first and second dies with a molten resin material by injecting said resin material from a central portion of said recess of the second die.

7. A process for manufacturing the molded resin casing according to Claim 6, wherein the central portion of the flat surface of said first die is

formed to have a hole (A3) for forming a support, said flexible board is clamped between said first and second dies in such a manner that the surface having said electric conductor patterns formed thereon is brought into abutting contact with the flat surface of said first die, the flexible board is punctured by injecting the molten resin material from the central portion of the recess of said second die so that the resin material fills the support forming hole of said first die, and the resin material fills the cavity between said first and second dies.

8. A process for manufacturing the molded resin casing according to Claim 6, wherein the size of the portion of the flexible board on which the electric conductor patterns are formed is formed to be a predetermined dimension larger than the flat surface of said first die, said flexible board is clamped between said first and second dies in such a manner that the surface having said electric conductor patterns formed thereon is brought into abutting contact with the flat surface of said first die, the cavity between the first and second dies is filled by injecting the molten resin material from the central portion of the recess of said second die, and said flexible board is deformed by being brought into close contact with the surface of said first die.

Patentansprüche

1. Geformtes Harzgehäuse eines elektronischen Bauteils, wobei das Gehäuse im Innern eine flexible Platte (3) beherbergt, auf der elektrische Leiterbahnen (3-5, 3-6, 3-7, 3-8, 3-9) ausgebildet sind, die mit Kontakten eines Schiebers des elektronischen Bauteils in Schleifkontakt stehen, wobei das Gehäuse die flexible Platte, die einen synthetischen Harzfilm und die auf dem synthetischen Harzfilm ausgebildeten elektrischen Leiterbahnen umfaßt, metallische Anschlußstücke (2-1, 2-2, 2-3, 2-4, 2-5), die mit oberen Oberflächen von Endabschnitten der elektrischen Leiterbahnen verbunden sind, einen einen synthetischen Harzfilm aus derselben Substanz wie derjenigen der flexiblen Platte umfassenden sicheren Harzfilm (2-6), der auf den metallischen Anschlußstücken angebracht ist, einen Endabschnitt, der durch lokales Verschmelzen des sicheren Harzfilms und des Films der flexiblen Platte derart, daß diese Filme distale Enden der metallischen Anschlußstücke Sandwich-artig umgeben, bereitgestellt wird, einschließt, wobei die flexible Platte (3) derart in das synthetische Harzgehäuse eingefügt ist, daß vorbestimmte

- Abschnitte der metallischen Anschlußstücke auf der Außenseite des Gehäuses freiliegen und daß die elektrischen Leiterbahnen im Innern des Gehäuses freiliegen, und derart, daß die flexible Platte und das synthetische Harzgehäuse in integrierter Form vorliegen.
2. Geformtes Harzgehäuse nach Anspruch 1, in welchem das Innere des synthetischen Harzgehäuses so geformt wird, daß es von im wesentlichen kreisförmiger Gestalt ist, ein Träger (1-1) für das frei drehbare Halten eines Rotors integral mit dem synthetischen Harzgehäuse an einem Mittelabschnitt davon gebildet wird und die elektrischen Leiterbahnen der flexiblen Platte in im wesentlichen konzentrischen Kreisen in einem inneren, den Träger in der Mitte aufweisenden Bodenabschnitt des Gehäuses freiliegen.
3. Geformtes Harzgehäuse nach Anspruch 1 oder 2, in welchem die flexible Platte so ausgebildet ist, daß sie um einen vorbestimmten Betrag größer ist als eine innere Bodenoberfläche des synthetischen Harzgehäuses und die elektrischen Leiterbahnen im inneren Bodenabschnitt des Gehäuses und an einer äußeren peripheren Oberfläche des Trägers oder einer inneren Oberfläche einer Seitenwand freiliegen.
4. Geformtes Harzgehäuse nach Anspruch 1, in welchem das Innere des synthetischen Harzgehäuses in rechteckiger Gestalt derart ausgebildet ist, daß der Schieber einer elektronischen Komponente vom Schiebe-Typ gleiten kann und die elektrischen Leiterbahnen der flexiblen Platte im wesentlichen parallel zu Längsseiten der rechteckigen Gestalt ausgebildet sind.
5. Geformtes Harzgehäuse nach Anspruch 4, in welchem die flexible Platte so ausgebildet ist, daß sie um einen vorbestimmte Betrag größer ist als die Oberfläche des Inneneboden des synthetischen Harzgehäuses und die elektrischen Leiterbahnen am Bodenabschnitt und an einer inneren Oberfläche einer Seitenwand des synthetischen Harzgehäuses freiliegen.
6. Verfahren zur Herstellung des geformten Harzgehäuses nach irgendeinem der Ansprüche 1 bis 5 eines elektronischen Bauteils, wobei das Gehäuse im Innern eine flexible Platte (3), auf der elektrische Leiterbahnen (3-5, 3-6, 3-7, 3-8, 3-9) ausgebildet sind, die mit Kontaktten eines Schiebers des elektronischen Bauteils in Schleifkontakt stehen, beherbergt, wobei das Gehäuse die flexible Platte, die einen synthetischen Harzfilm und die auf dem synthetischen Harzfilm ausgebildeten elektrischen Leiterbahnen umfaßt, metallische Anschlußstücke (2-1, 2-2, 2-3, 2-4, 2-5), die mit oberen Oberflächen von Endabschnitten der elektrischen Leiterbahnen verbunden sind, einen einen synthetischen Harzfilm aus derselben Substanz wie derjenigen der flexiblen Leiterplatte umfassenden sicheren Harzfilm (2-6), der auf den metallischen Anschlußstücken angebracht ist, einen Endabschnitt, der durch lokales Verschmelzen des sicheren Harzfilms und dem Film der flexiblen Platte derart, daß die Filme distale Enden der metallischen Anschlußstücke Sandwichtig umgeben, bereitgestellt wird, beinhaltet, wobei die flexible Platte derart in das synthetische Harzgehäuse eingefügt ist, daß vorbestimmte Abschnitte der metallischen Anschlußstücke auf der Außenseite des Gehäuses freiliegen und die elektrischen Leiterbahnen im Innern des Gehäuses freiliegen, und derart, daß die flexible Platte und der synthetische Harzfilm in integrierter Form vorliegen, umfassend die folgenden Schritte:
25. Herstellung eines ersten Werkzeugs (A), das eine flache Oberfläche (A1), welche in engen Kontakt mit der Oberfläche der flexiblen Platte, die den Harzfilm, auf dem die elektrischen Leiterbahnen ausgebildet sind, umfaßt, gebracht wird, und eine um die Peripherie der flachen Oberfläche herum ausgebildete Nut (A2) zur Bildung eines Seitenabschnitts des synthetischen Harzgehäuses aufweist, und eines zweiten Werkzeug (B), das gegenüber dem ersten Werkzeug angebracht wird und eine den Gehäusenäden bildende Aussparung (B1) an einem Abschnitt davon aufweist, der dem Abschnitt des ersten Werkzeugs entspricht, der die flache Oberfläche und wenigstens einen Teil der Nut einschließt;
30. Festklemmen der flexiblen Platte zwischen dem ersten Werkzeug (A) und dem zweiten Werkzeug (B) in solcher Weise, daß die Oberfläche mit den darauf ausgebildeten elektrischen Leiterbahnen in aneinanderstoßenden Kontakt mit der flachen Oberfläche des ersten Werkzeugs gebracht wird; und
35. Füllen eines Hohrraums zwischen dem ersten und dem zweiten Werkzeug mit einem geschmolzenen Harzmaterial durch Einspritzen des Harzmaterials von einem Mittelabschnitt der Aussparung des zweiten Werkzeugs aus.
40. Verfahren zur Herstellung des geformten Harzgehäuses nach Anspruch 6, in welchem der Mittelabschnitt der flachen Oberfläche des ersten Werkzeugs so ausgebildet wird, daß er ein Loch (A3) zur Bildung eines Trägers auf-

weist, die flexible Platte derart zwischen dem ersten und zweiten Werkzeug eingeklemmt wird, daß die Oberfläche mit den darauf ausgebildeten elektrischen Leiterbahnen in anstoßenden Kontakt mit der flachen Oberfläche des ersten Werkzeugs gebracht wird die flexible Platte durch Einspritzen von geschmolzenem Harzmaterial von dem Mittelabschnitt der Ausparung des zweiten Werkzeugs aus so durchstoßen wird, daß das Harzmaterial das den Träger bildende Loch des ersten Werkzeugs füllt, und das Harzmaterial den Hohrraum zwischen dem ersten und zweiten Werkzeug füllt.

8. Verfahren zur Herstellung des geformten Harzgehäuses nach Anspruch 6, worin die Größe des Abschnitts der flexiblen Platte, auf dem die elektrischen Leiterbahnen ausgebildet sind, so hergestellt wird, daß sie um eine vorbestimmte Abmessung größer ist als die flache Oberfläche des ersten Werkzeugs, die flexible Platte zwischen dem ersten und zweiten Werkzeug derart festgeklemmt wird, daß die Oberfläche mit den darauf ausgebildeten elektrischen Leiterbahnen in anstoßenden Kontakt mit der flachen Oberfläche des ersten Werkzeugs gebracht wird, der Hohrraum zwischen dem ersten und zweiten Werkzeug durch Einspritzen des geschmolzenen Harzmaterials vom Mittelabschnitt der Ausparung des zweiten Werkzeugs aus gefüllt wird, und die flexible Platte durch in engen Kontakt-Bringen mit der Oberfläche des ersten Werkzeugs verformt wird.

Revendications

1. Boîtier en résine moulée d'un élément électronique, ce boîtier recevant intérieurement une carte souple (3) sur laquelle sont formées des configurations conductrices électriquement (3-5, 3-6, 3-7, 3-8, 3-9) en contact glissant avec les contacts d'un curseur de l'élément électronique, ledit boîtier comprenant ladite carte souple étant constitué d'un film en résine de synthèse et des configurations conductrices électriquement formées sur ledit film en résine de synthèse, des pièces de bornes métalliques (2-1, 2-2, 2-3, 2-4, 2-5) étant reliées aux surfaces supérieures de parties d'extrémité desdites configurations conductrices électriquement, un film (2-6) en résine de fixation étant constitué d'un film en résine de synthèse de la même substance que ladite carte souple, placé sur lesdites pièces de bornes métalliques, une partie de borne étant obtenue en faisant fondre localement ledit film en résine de fixation et le film de ladite carte souple de manière à enserrer les extrémités éloignées des pièces de

- 5 bornes métalliques, ladite carte souple (3) étant insérée dans le boîtier en résine de synthèse de manière que des parties pré-déterminées desdites pièces de bornes métalliques soient exposées à l'extérieur du boîtier et que ledites configurations conductrices électriquement soient exposées à l'intérieur du boîtier, et de manière que ladite carte souple et le boîtier en résine de synthèse soient intégrés.
- 10 2. Boîtier en résine moulée selon la revendication 1, dans lequel l'intérieur dudit boîtier en résine de synthèse est formé pour avoir une forme sensiblement circulaire, un support (1-1) pour supporter un rotor à rotation libre est formé d'une seule pièce avec le boîtier en résine de synthèse dans une partie centrale de celui-ci, et lesdites configurations conductrices électriquement de ladite carte souple sont exposées selon des cercles sensiblement concentriques à une partie interne du fond du boîtier avec ledit support au centre.
- 15 3. Boîtier en résine moulée selon la revendication 1 ou 2, dans lequel ladite carte souple est formée pour être plus large d'une quantité pré-déterminée qu'une surface interne du fond du boîtier en résine de synthèse, et lesdites configurations conductrices électriquement sont exposées à la partie interne du fond dudit boîtier et à une surface périphérique externe du support ou une surface interne d'une paroi latérale.
- 20 4. Boîtier en résine moulée selon la revendication 1, dans lequel l'intérieur dudit boîtier en résine de synthèse est formé pour avoir une forme rectangulaire de manière que le curseur d'un composant électronique du type à curseur puisse glisser, et les configurations conductrices électriquement de ladite carte souple sont formées de manière à être sensiblement parallèles aux longs côtés de la forme rectangulaire.
- 25 5. Boîtier en résine moulée selon la revendication 4, dans lequel ladite carte souple est formée pour être plus grande d'une valeur pré-déterminée que la surface interne du fond du boîtier en résine de synthèse, et lesdites configurations conductrices électriquement sont exposées à la partie de fond et à une surface interne d'une paroi latérale dudit boîtier en résine de synthèse.
- 30 6. Procédé de fabrication du boîtier en résine de synthèse moulée selon l'une quelconque des revendications 1 à 5, d'un élément électroni-

que, le boîtier recevant intérieurement une carte souple (3) sur laquelle sont formées des configurations conductrices électriquement (3-5, 3-6, 3-7, 3-8, 3-9) en contact glissant par les contacts d'un curseur de l'élément électronique, ledit boîtier comprenant ladite carte souple étant constitué d'un film en résine de synthèse et des configurations conductrices électriquement formées sur ledit film en résine de synthèse, des pièces de bornes métalliques (2-1, 2-2, 2-3, 2-4, 2-5) étant reliées aux surfaces supérieures des parties d'extrémité desdites configurations conductrices électriquement, un film (2-6) en résine de fixation étant constitué d'un film en résine de synthèse de la même substance que celle de ladite carte souple placé sur lesdites pièces de bornes métalliques, une partie de borne étant obtenue en faisant fondre localement ledit film en résine de fixation et le film de ladite carte souple de manière à enserrer les extrémités éloignées des pièces de bornes métalliques, ladite carte souple étant insérée dans le boîtier en résine de synthèse de manière que des parties pré-déterminées desdites pièces de bornes métalliques soient exposées à l'extérieur du boîtier et que lesdites configurations conductrices électriquement soient exposées à l'intérieur dudit boîtier, et de manière que ladite carte souple et le boîtier en résine de synthèse soient intégrés, comprenant les étapes de:

préparation d'une première matrice (A) ayant une surface plate (A1) qui est mise en contact étroit avec la surface de la carte souple comprenant ledit film de résine sur lequel sont formées les configurations conductrices électriquement, et une rainure (A2) formée autour de la périphérie de ladite surface plate pour former une partie latérale du boîtier en résine de synthèse, et une seconde matrice (B) disposée à l'opposé de ladite première matrice et ayant un creux (B1) de formation du fond du boîtier, formé dans sa partie correspondant à la partie de ladite première matrice qui comporte ladite surface plate et au moins une partie de ladite rainure;

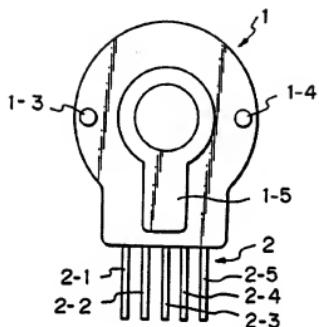
fixation de ladite carte souple entre ladite première matrice (A) et ladite seconde matrice (B) de manière que la surface sur laquelle sont formées lesdites configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice; et

remplissage d'une cavité entre lesdites première et seconde matrices avec un matériau en résine fondu en injectant ledit matériau en résine depuis une partie centrale dudit creux de la seconde matrice.

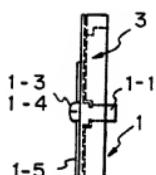
- 5 7. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel la partie centrale de la surface plate de ladite première matrice est formée pour comporter un trou (A3) pour former un support, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées lesdites configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la carte souple est perforée en injectant le matériau en résine fondu depuis la partie centrale du creux de ladite seconde matrice de telle sorte que le matériau de résine remplit le trou formant support de ladite première matrice, et que le matériau de résine remplit la cavité entre lesdites première et seconde matrices.
- 10 8. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 15 9. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 20 10. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 25 11. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 30 12. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 35 13. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 40 14. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 45 15. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 50 16. Procédé de fabrication du boîtier en résine moulée selon la revendication 6, dans lequel les dimensions de la partie de la carte souple sur laquelle sont formées les configurations conductrices électriquement sont formées pour être supérieures d'une valeur pré-déterminée à la surface plate de ladite première matrice, ladite carte souple est fixée entre lesdites première et seconde matrices de manière que la surface sur laquelle sont formées les configurations conductrices électriquement soit mise en contact étroit avec la surface plate de ladite première matrice, la cavité entre les première et seconde matrices est remplie en injectant le matériau de résine fondu depuis la partie centrale du creux de ladite seconde matrice, et ladite carte souple est déformée en étant mise en contact étroit avec la surface de ladite première matrice.
- 55

Fig. 1

(A)



(B)



(C)

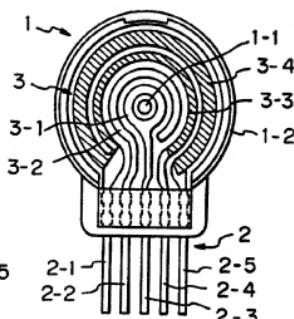


Fig. 2

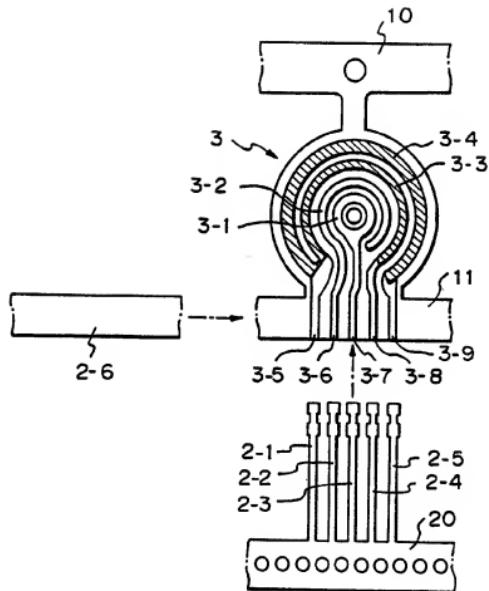
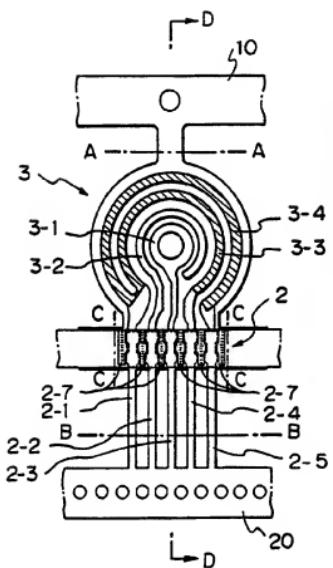


Fig. 3

(A)



(B)

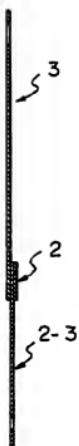


Fig. 4

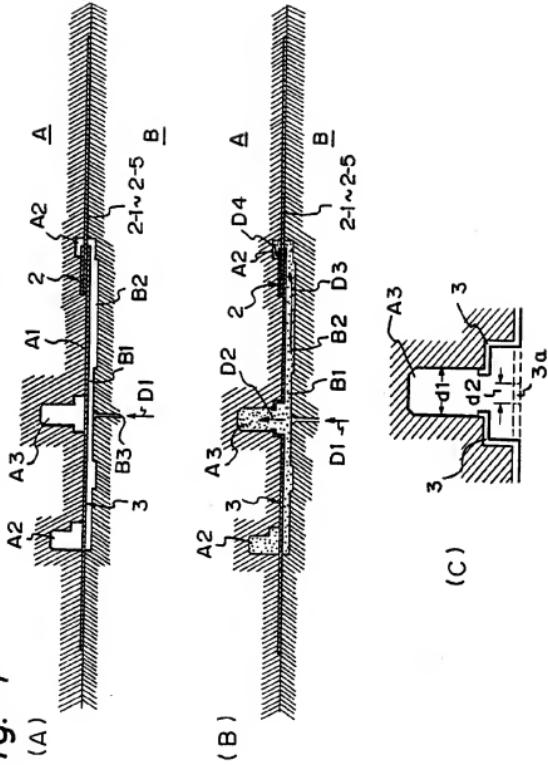


Fig. 5

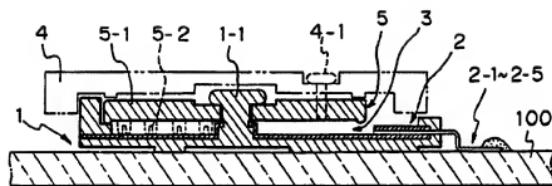


Fig. 8

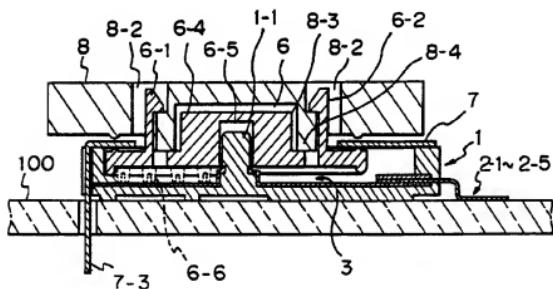
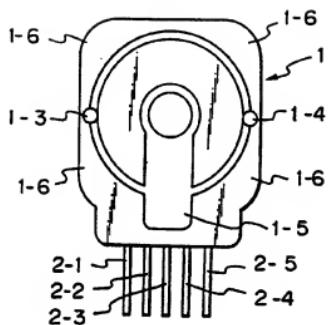
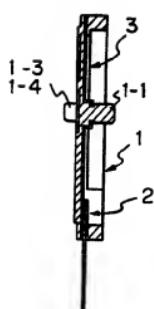


Fig. 6

(A)



(B)



(C)

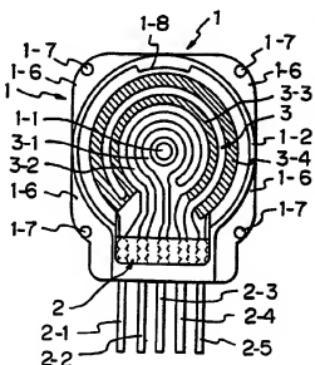


Fig. 7

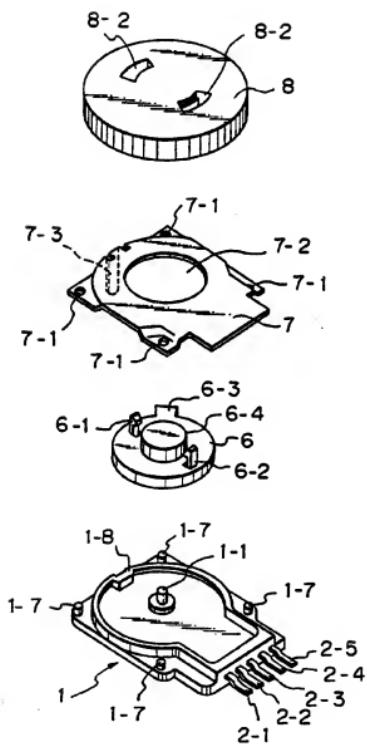
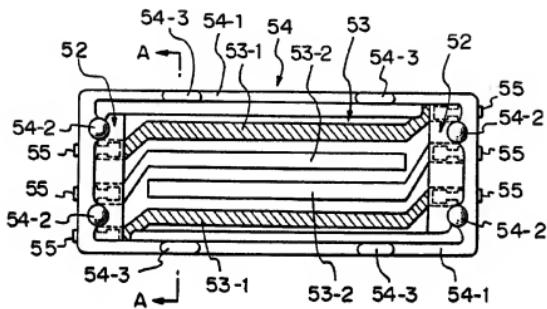


Fig. 9

(A)



(B)

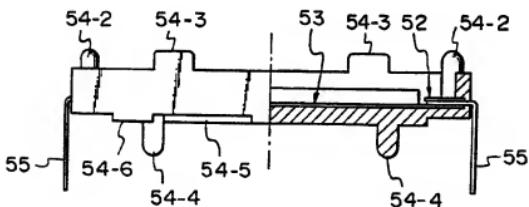
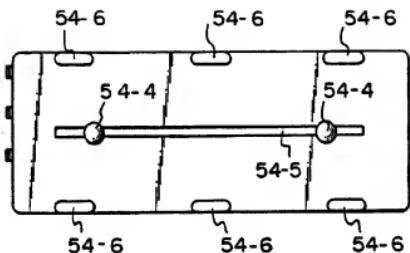


Fig. 9

(C)



(D)

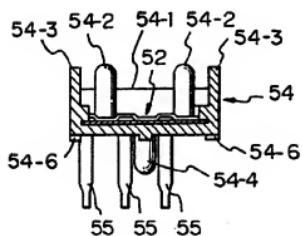


Fig. 10

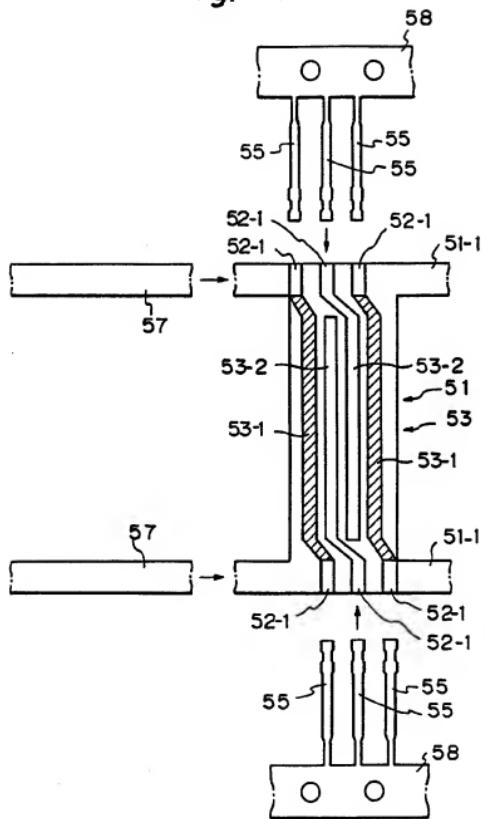


Fig. 11

(A)

(B)

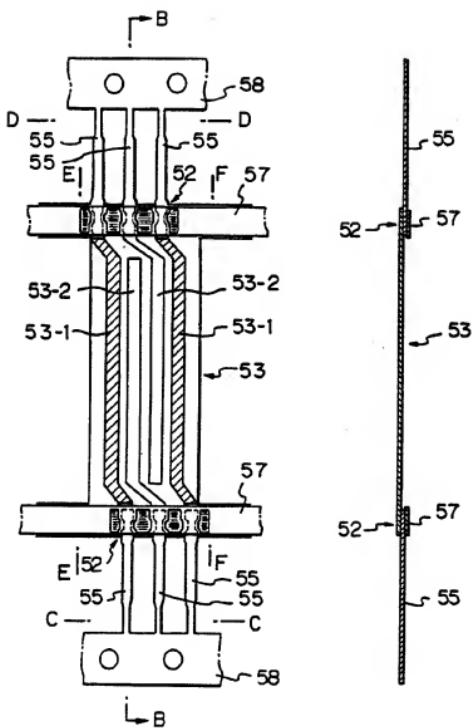


Fig. 12

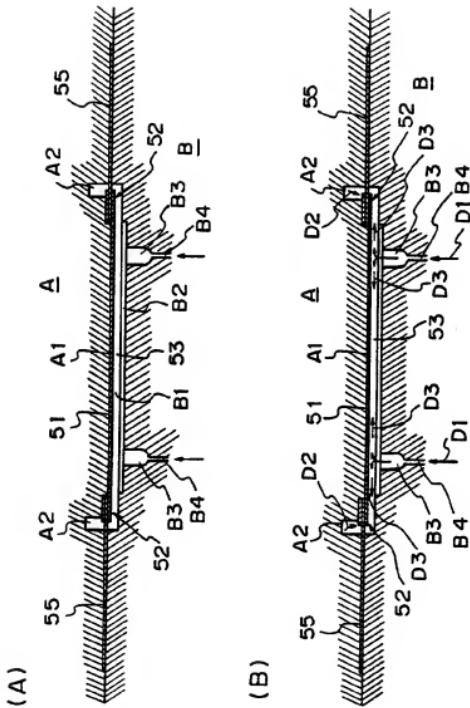


Fig. 13

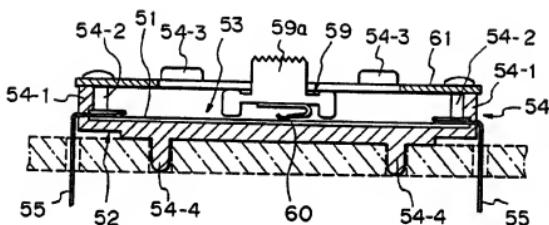


Fig. 14

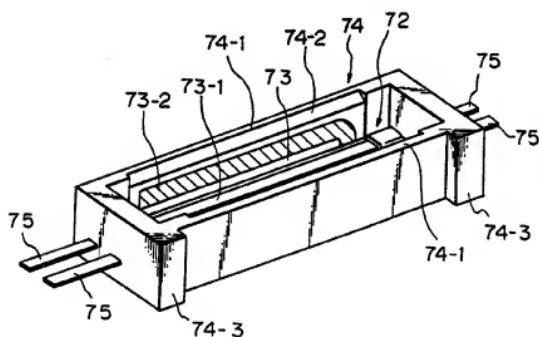


Fig. 15

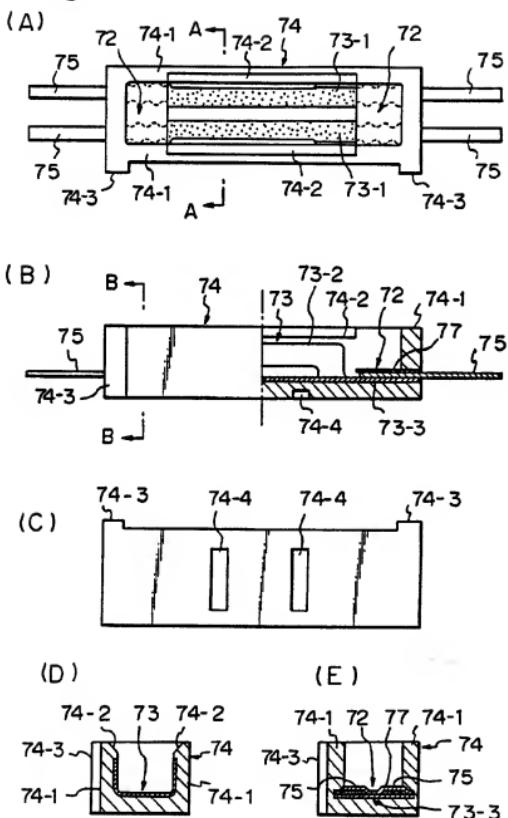


Fig. 16

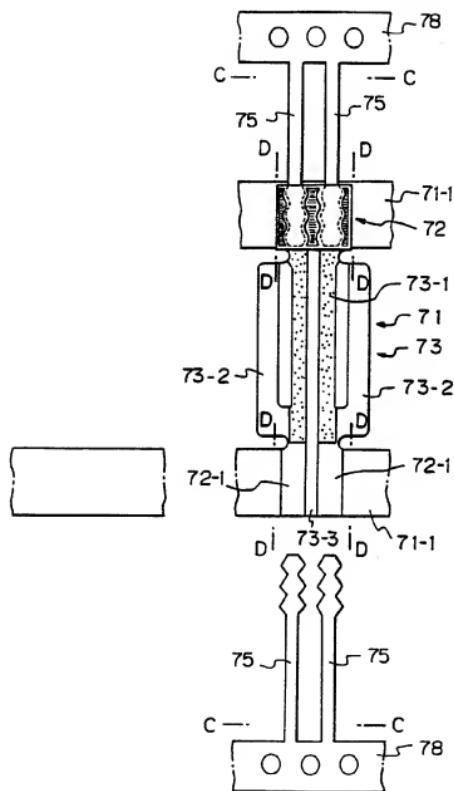


Fig. 17

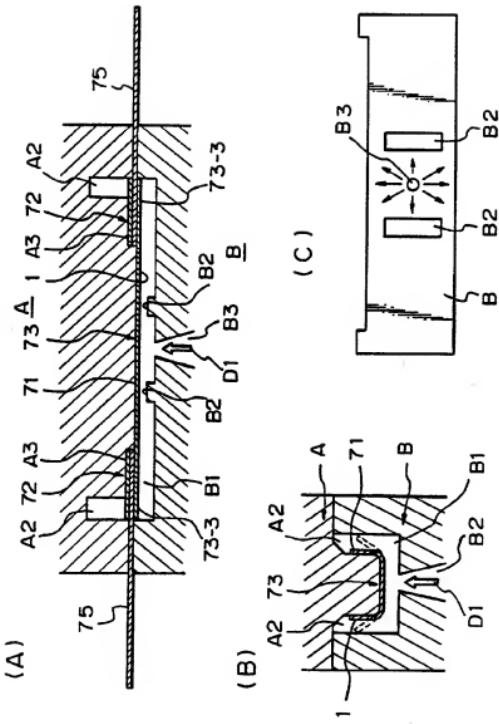


Fig. 18

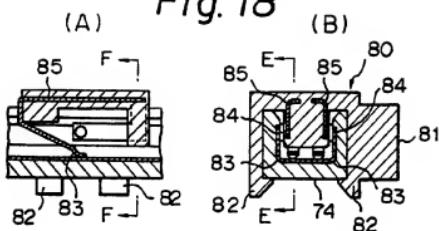


Fig. 19

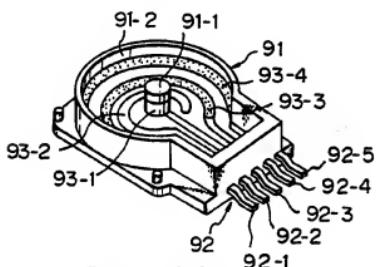


Fig. 20

